GUJARAT TECHNOLOGICAL UNIVERSITY

DIPLOMA IN METTALLURGY ENGINEERING

SEMESTER: V

Subject Name: **Physical Metallurgy - II**

Sr. No.	Course Content
1.	**Introduction to Metals & Alloys:** 1.1 Metals, Alloys and their structural constituents, systems & phases. 1.2 Thermodynamic consideration of phase transformations. 1.3 Equilibrium diagrams & cooling curves. 1.4 Types of systems.
2.	**Iron-Carbon Equilibrium Diagram:** 2.1 Definitions. 2.2 Critical points & invariant points / allotropic forms. 2.3 Phases & micro constituents and their effect on mechanical properties. 2.4 Transformations in different carbon % ranges.
3.	**Heat Treatment of Steel:** 3.1 Definition. 3.2 Annealing and normalizing. 3.3 Hardening and tempering. 3.4 Austempering and martempering. 3.5 Hardenability. 3.6 Surface hardening.
4.	**TTT and CCT Diagrams:** 4.1 Definition and its importance. 4.2 Construction of TTT diagram. 4.3 Types of TTT diagram for different steels. 4.4 Factors affecting TTT diagram and it's limitations. 4.5 CCT diagram.
5.	**Plain Carbon Steels:** 5.1 Classification and importance. 5.2 Explain relationship between Carbon, microstructure and mechanical properties. 5.3 Application of different plain carbon steels. 5.4 Limitations of plain carbon steels. 5.5 Effects of alloying elements to overcome limitations of plain carbon steels.
6.	**Cast Iron:** 6.1 Definition and classification 6.2 Different types of cast iron. 6.3 Heat treatment of cast iron. 6.4 Methods to improve properties of cast iron. 6.5 Effect of alloying elements.

7.	**Physical Metallurgy of Non-Ferrous Metals and Alloys:** 7.1 Copper and its alloys: Composition, properties, uses and microstructure. 7.2 Heat treatment of copper and its alloys. 7.3 Aluminum and its alloys: Composition, properties, uses and Microstructure. 7.4 Heat treatment of Al-Cu alloys. 7.5 Non-ferrous bearing alloys : Composition, properties, uses and Microstructure.
8.	**Tool Steels:** 8.1 Classification. 8.2 High speed tool steels(HSS): classification, composition, heat treatment.
9.	**Stainless Steels:** 9.1 Classification. 9.2 Austenitic stainless steels: Types, composition, properties, application. 9.3 Ferritic stainless steels: Types, composition, properties, application. 9.4 Martensitic stainless steels :Types, composition, properties, application. 9.5 precipitation hardened stainless steels: Types, composition, properties, application.

Laboratory Experiments:

1. Preparation of metallic specimen for microscopic examination as per I.S. code.
2. Photo metallography as per I.S. code.
3. Study of equilibrium diagram.
4. Study of iron carbon equilibrium diagram.
5. Distinguish microstructures of plain carbon steels.
6. Distinguish of microstructure of various types of C.I.
7. Identify distinct features of microstructure of non ferrous metals and alloys and antifriction bearing alloys.
8. Micro examination of annealed and normalized steel samples and performance of hardening test to co-relate microstructures with hardness.
9. Micro examination of hardened and tempered steel samples and performance hardness test to co-relate microstructures with hardness.
10. Inclusion rate measurement as per IS code 4163-1961.